Pre-release
Harmonie-38h1 Validation
& Harmonie practice with pre-release validation

Xiaohua Yang, DMI

Acknowledgement: Some materials contributed from Ulf Andrae, Sami Niemela, Markku kangas

Outline

1. Experiences with evaluation of 38h1 so far
2. HARMONIE evaluation & validation: targets, participants, tools, processes, perspectives

ASM 2011 QA talk:
Pre-release 36h1.3 validation

Prior to official tagging of 36h1.3, a multi-month validation for selected episodes was organised with a group of HIRLAM developers for quality assurance

- Compared to previous taggings (35h1.3, 36h1.2)
- Three domains, various configurations about coupling/DA
- Obs verification and episodes examined

HARMONIE forecasts, grossly speaking, are found to have a comparable meteorological performances to those of HIRLAM

- These refer mainly to average model properties (pmsl, t2m, cloud, precipitation)
- Good potential shown for strong summer convection

Several obvious shortcomings were identified during the validation studies

- Severe wind bias in AROME, --- corrected in 36h1.4
- Severe problems in producing cold nordic winter temperature

Yang, ASM 2012

ASM 2012 QA talk:
Pre-release 37h1 validation and tuning

- Real time trunk – 37h1.alpha (~Oct 2010)

  “denmark”,”scandinavia_5.5” domains
- 37h1.beta1 (Dec 2011)

  “denmark”,”finland”,“iceland”,”iberia”, ”lithuania”,”ireland”,”nuuk”,”scandinavia_5.5”

  edmfm vs edkf; blending vs 3dvar; L60 vs L65
- 37h1.beta2 (Feb 2012)

  “denmark”, “finland”, “scandinavia_5.5

  edmfm, bug fixes, lsmixbc
- 37h1.1: (– June 2012)

  “denmark”

  edmfm, lsmixbc

Pre-release Validation in Harmonie

Mission: HIRLAM-B makes official HARMONIE releases with starting point on T-releases. The system is targeted to be suitable for research and operational use.

Purposes:

1. to have something to say to developers & users expected behaviours of the new release using default settings; the options; known deficiencies.
    - sanity check and basic scores
    - default features coming with the new release
    - eventually, new options behind switches
    - known deficiencies from previous versions
2. improve, if possible, detected deficiencies

38h1

1. New features
   - Surfex 7.2! pmmc; remote sensing capability; advantages in computational aspects; 3h cycling; extended domain;
2. System week Oslo 201209 & 38h1.a1, 201301
   - 'semi-stable' version. With AROME-blending option working. Other things (3DVAR, EPS, climate, MUSC) broken or untested
3. System week Dublin 201303 & 38h1.a2, 201303
   - + 3DVAR, alaro without surfex, MUSC
   - still semi-stable. Some problem with humidity analysis?
4. Feb 2013: Call for evaluation & validation
   - AEMET, DMI,FMI, KNMI, met.no, SMHI, metcoop, MetEireann
   - multi-domain, multi-platform

First RCR scheduled

Features to be checked, 38h1

1. sanity check and basic scores
2. features related to new upgrades in 38h1 (surfex 7.2, physiogaphic data base, successor of EDKF, DA-varbc, obs handling..)
3. main issues and known deficiencies from previous versions
   - Nordic temperature problem; SBL; winter time T bias
   - fog/low cloud over sea and over land
   - surface wind over mountains/Greenland/Iceland
   - negative humidity after analysis
   - SODA or OI_main: handing of surface features in interpolation/extrapolation
   - radiation ... ...

38h1, Present Status

Evaluation:

- trunk runs at real time
  - ECMWF, since Jan 2013 on
  - domains: DENMARK, DKCOEXP
  - blending, 3DVAR
- test with 38h1.alpha1
  - historical summer/winter episodes, two domains

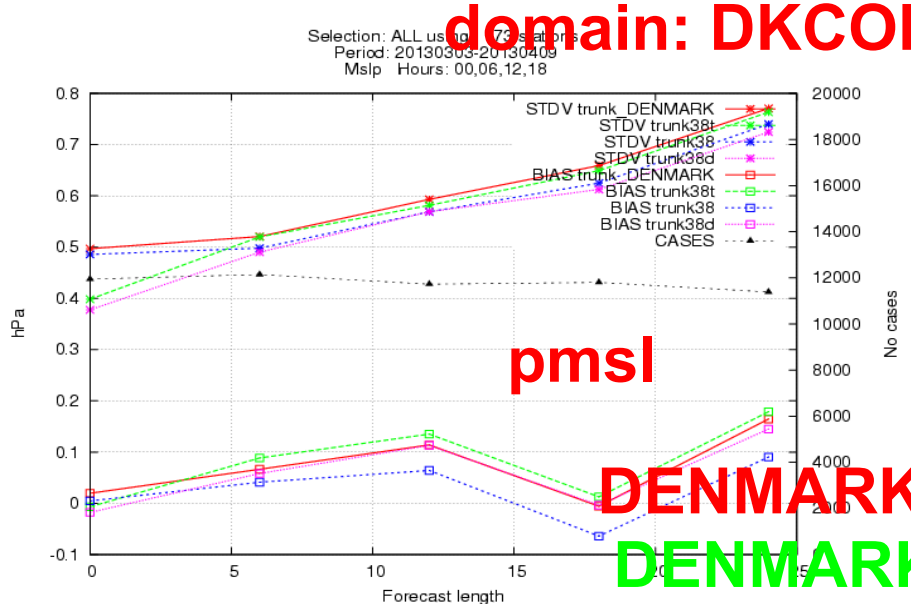
Validation 38h1.alpha2

- DKCOEXP, summer/winter,3DVAR & blending
- FINLAND, blending, summer/winter
- so far only monitoring scores have been looked at

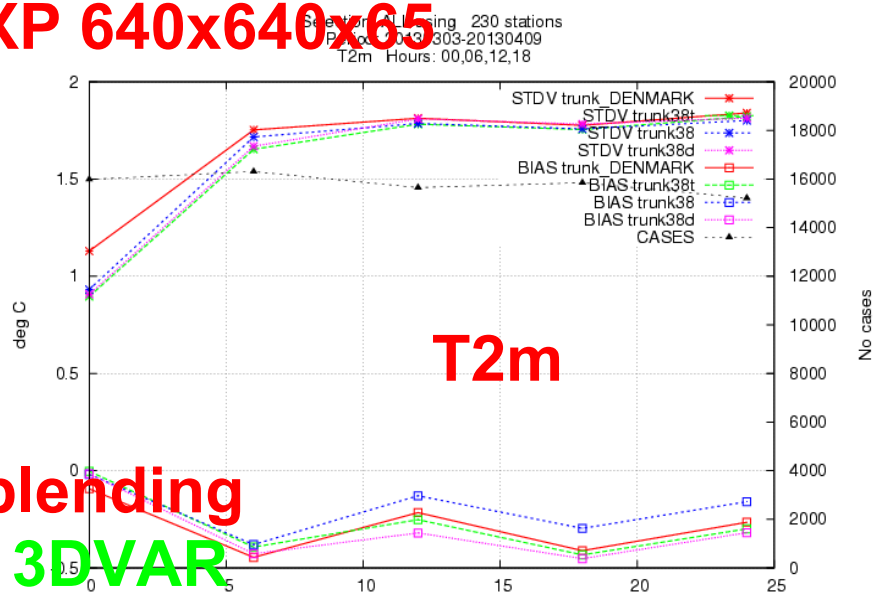
Status update on HIRLAM-wiki:

- https://hirlam.org/trac/wiki/Harmonie_38h1/ValidationTests

test with 3DVAR & the new default HARMONIE domain: DKCOEXP 640x640x65



pmsl



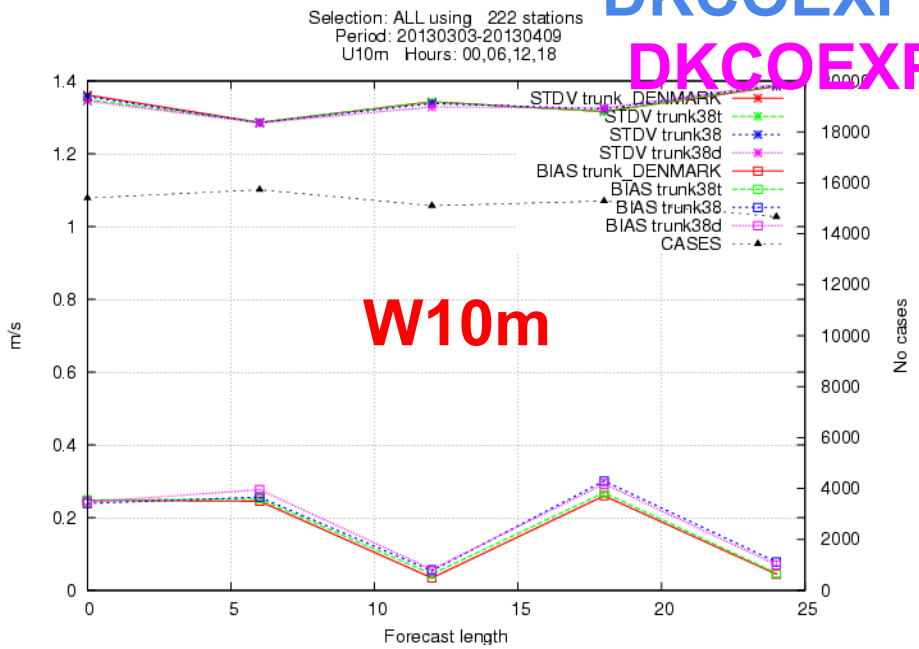
T2m

DENMARK,blending

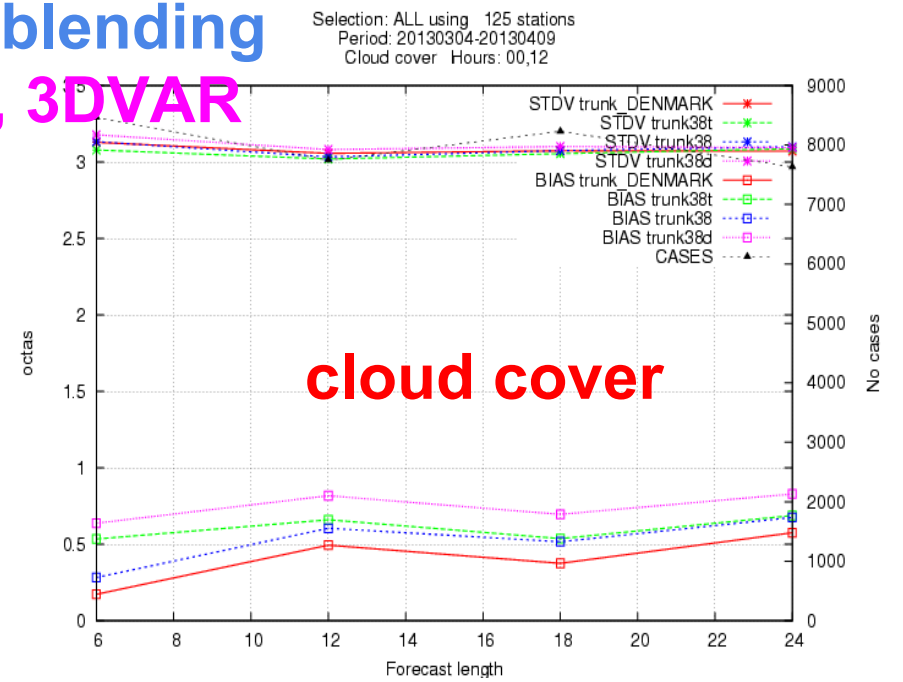
DENMARK, 3DVAR

DKCOEXP, blending

DKCOEXP, 3DVAR



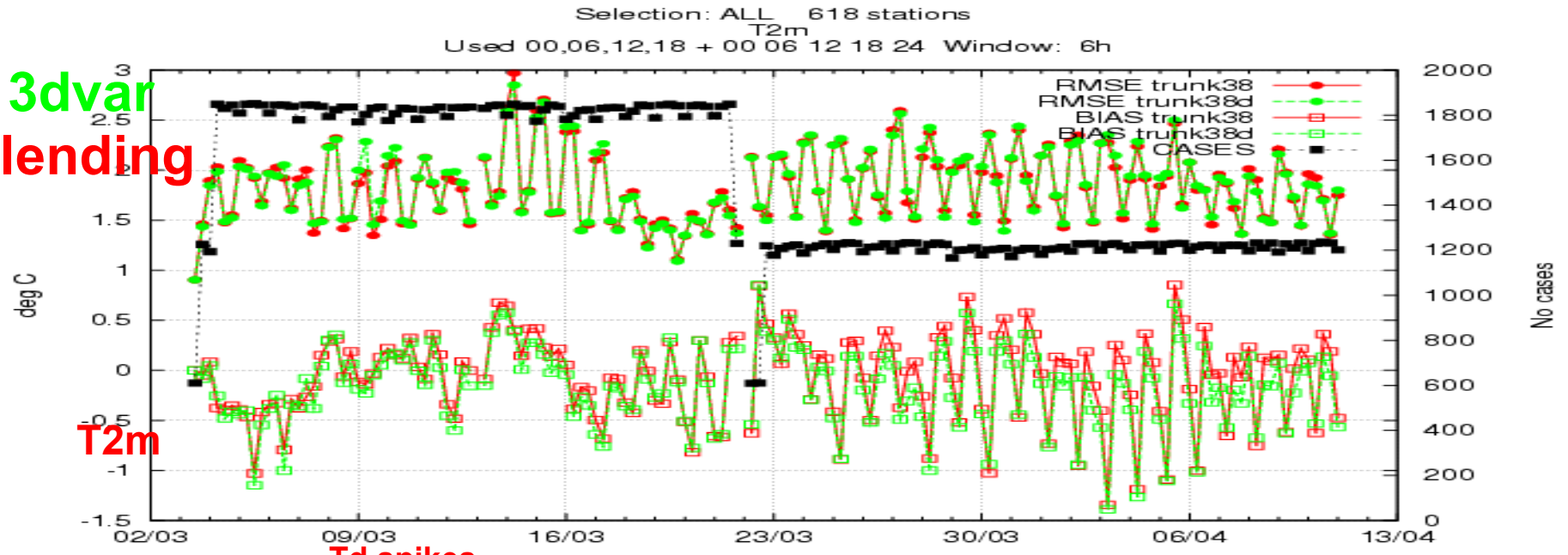
W10m



cloud cover

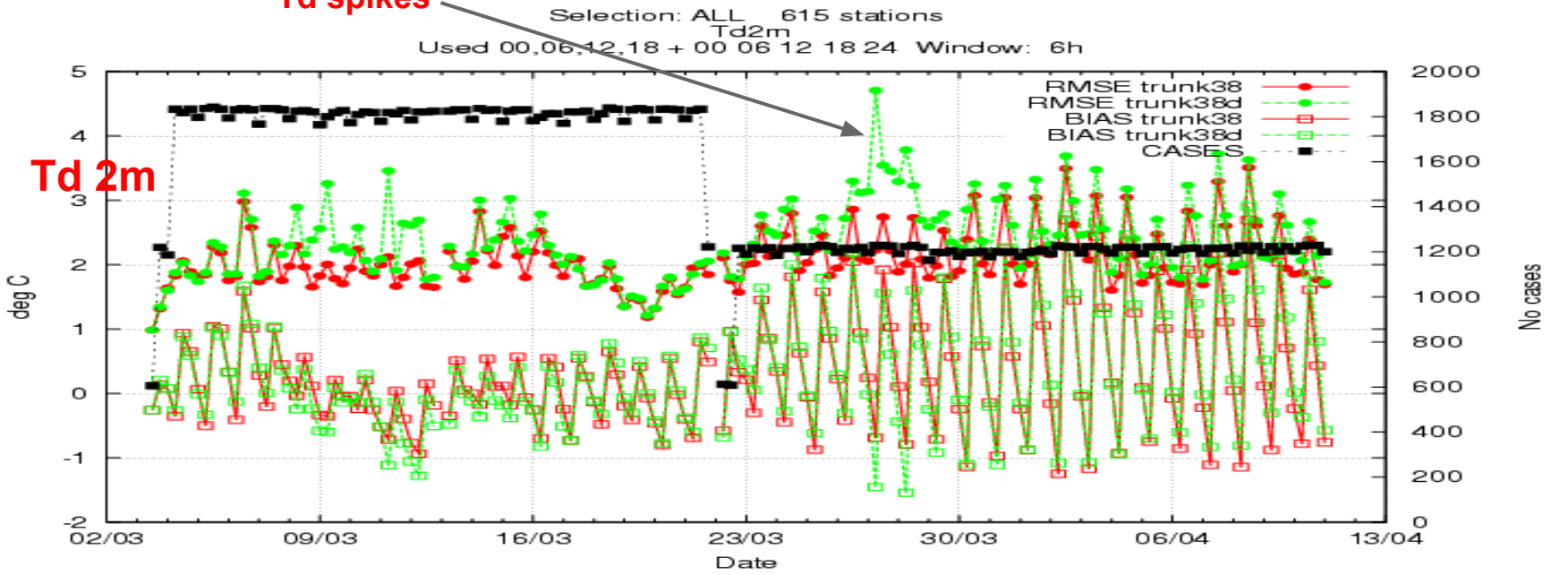
3DVAR humidity analysis problem in 38h1?

3dvar blending

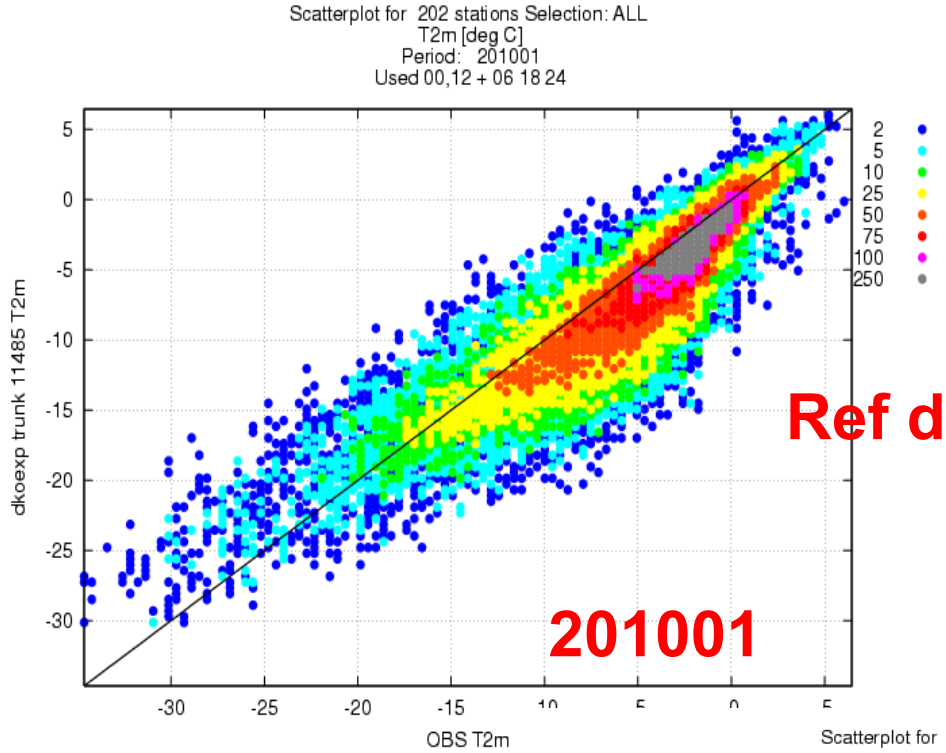


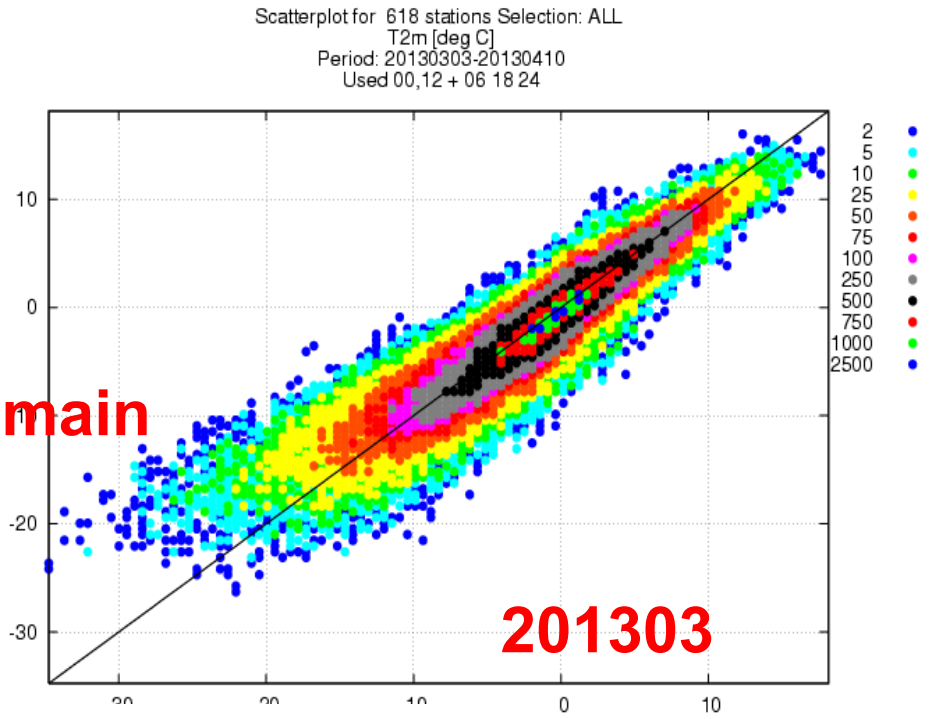
T2m

Td spikes

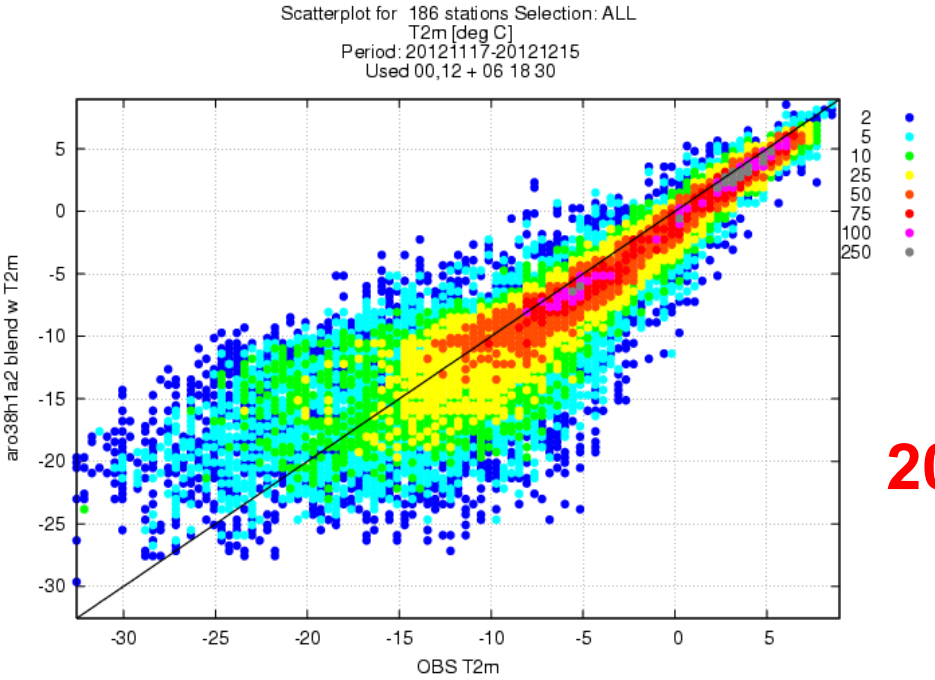


Td 2m



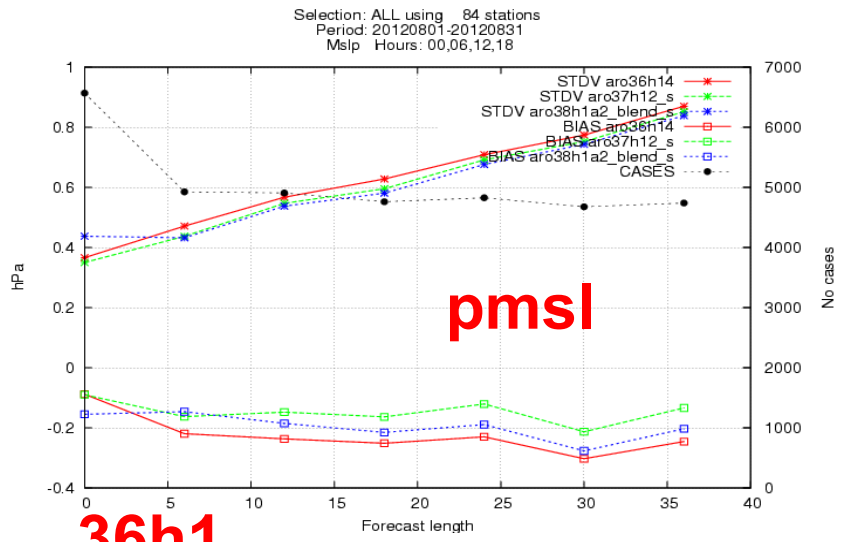


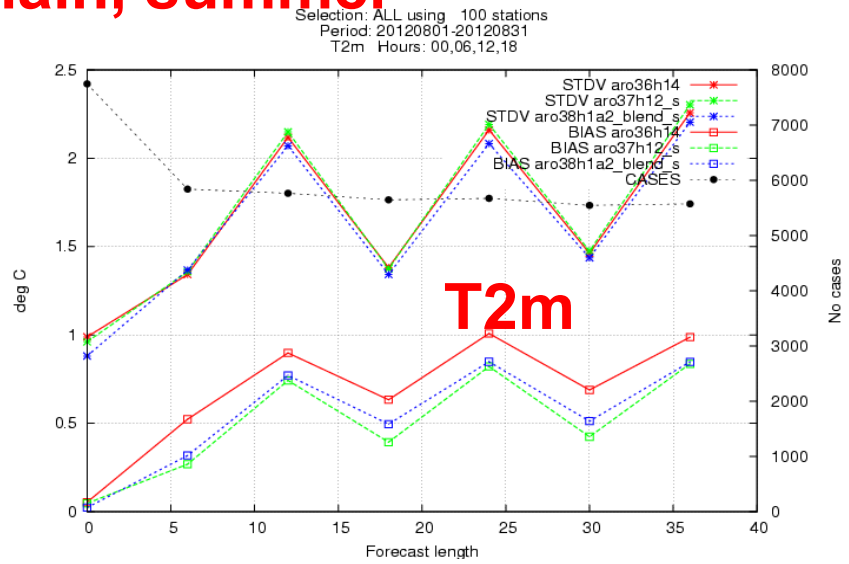
Ref domain



FMI domain

FINLAND domain, summer

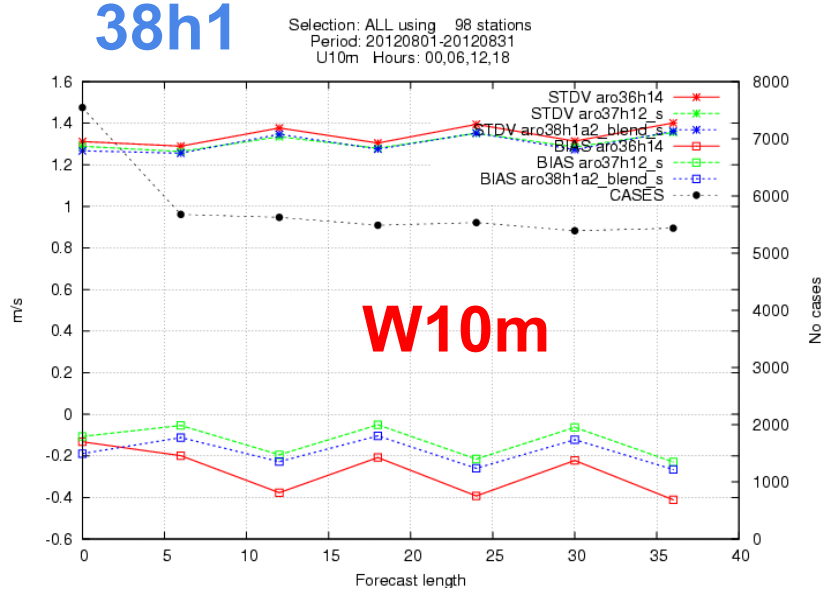


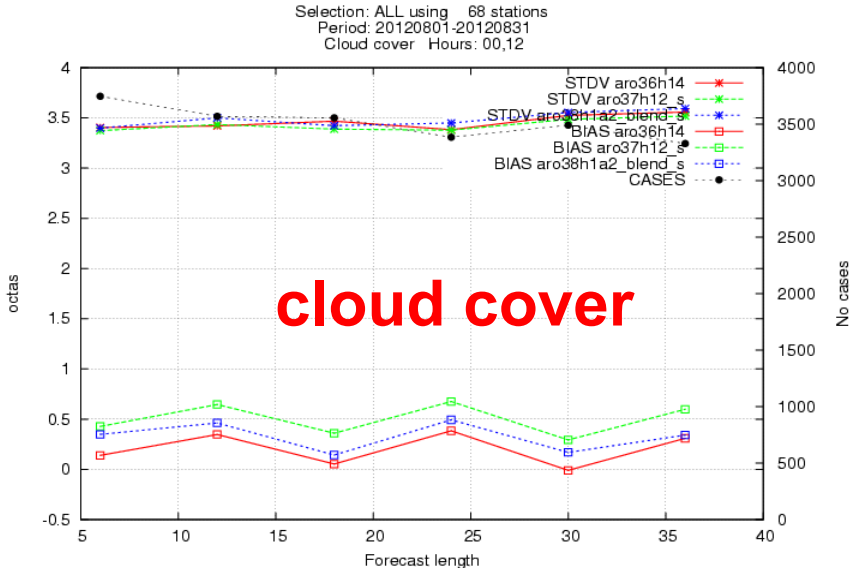


36h1

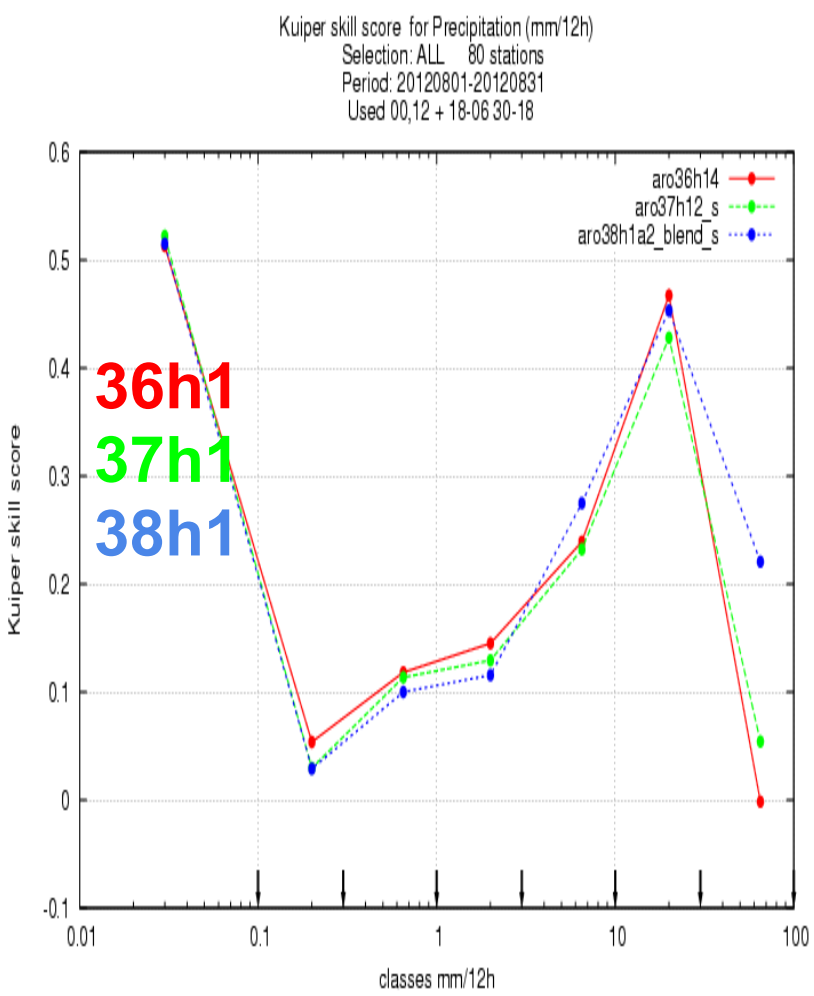
37h1

38h1

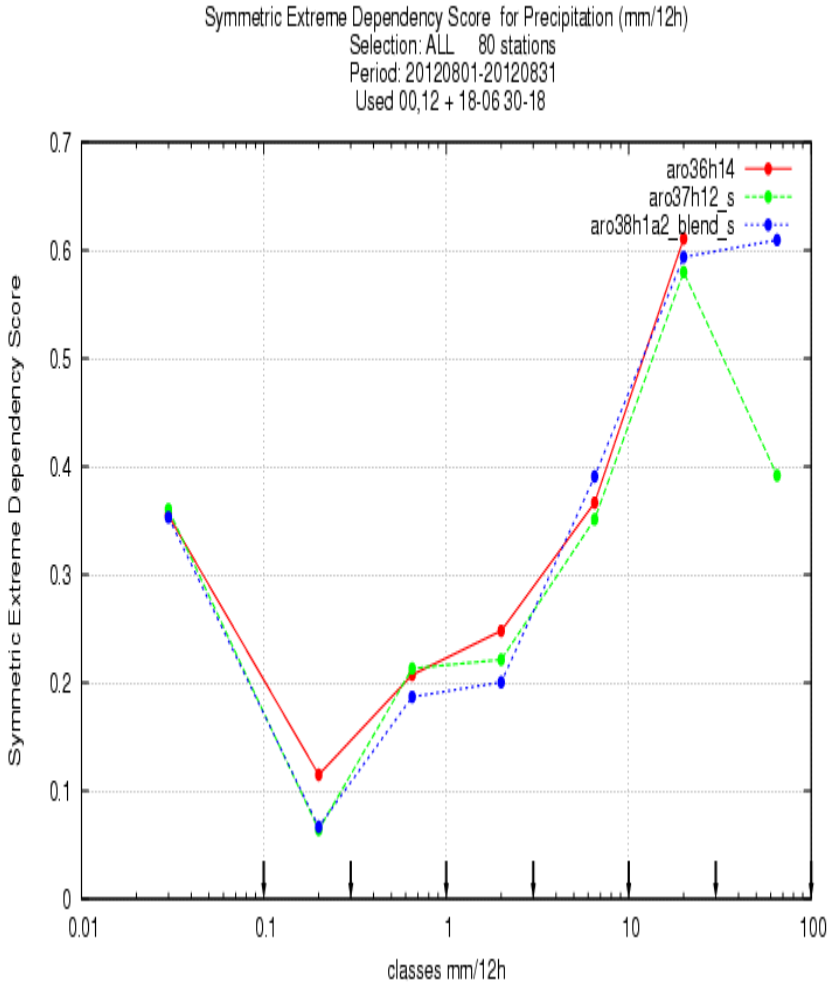




KH score



SEDS score



Precipitation, FINLAND domain, summer

38h1, first impressions

- Real time suite (winter period) showed no significant differences from 37h1.2. some improvement on precipitaiton at high threshhold
  - forecast "bust" of Td2m
  - winter time T2m bias
  - sanity of 3DVAR to be further checked
    - negative humidity
- Test on historical episodes showed small degradation in wind, T2m for winter time
  - winter time T2m bias
- test on FINLAND domain shows comparable scores with 37h1, both improved surface scores over the operational 36h1.3 for summer

Follow the update on HIRLAM-wiki:

https://hirlam.org/trac/wiki/Harmonie_38h1/ValidationTests

Pre-release Validation in Harmonie

Mission: HIRLAM-B makes official HARMONIE releases with source ported from T-series. The system is targeted to be suitable for research and operational use.

Purposes:

1. to have something to say to developers & users: the expected behaviours of the new release with default settings, the options; known deficiencies.
    - sanity check, basic scores
    - default features coming with the new release
    - eventually, a check about new options behind switches
    - known deficiencies from previous versions
2. improve, if possible, on detected deficiencies!

From 36h1 to 37h1

Issues seen & addressed

Scripts problems, namelist settings → many corrections & taggable now!

Lengthy soil spinup → swi conversion improved

Increased wind bias → improved with canopy_drag/sso tuning

Increased cloud bias → gone (bug correction or elsewhere?)

edmfm update chaos → adjusted and back to default

Parallelisation and reproducibility of AROME, edmfm → improved and assured

Stability of arome model

Bugs in spectral nudging code... → corrected

LSMIXBC → corrected and now default

Shortcomings in utility, post-processing → improved but incomplete

Yang, ASM 2012

Main conclusions/outcomes

- 37h1 (arome, alaro) at least no worse than 36h1.4
  - Swi conversion, improves greatly soil spin-up
  - Surface wind reduced, mostly better except for mountain area
  - Mslp and upper air scores improved with LSMIXBC
- Final tests with 37h1-arome indicates further improvement
  - Precipitation improved
  - No more degradation in cloud amount
- As such, 37h1 is now recommendable to HIRLAM operational services, but pre-launch local evaluation and tuning is recommended

Yang, ASM 2012

From 37h1.alpha to 37h1

Validation & tuning experiments

Harmonie_37h1/ValidationTests – HIRLAM - Mozilla Firefox

File Edit View History Bookmarks Tools Help

https://hirlam.o...D36_ALAD37_old/ | Velkommen - Jægerhytten | Surface significane test Fig: ALL;M... | Harmonie_37h1/ValidationTests – ... | Timeline – HIRLAM

hirlam.org https://hirlam.org/trac/wiki/Harmonie_37h1/ValidationTests

CALIFORNIA SUITES HOTEL

Lists of validation experiments

Experiment	Domain	Model Version	Physics	LA Area	Surface Area	LSMIXBC	Condensation option	Start of Episode	End of Episode	Observation Verification
~snh/hm_home/arome_DENMARK_r10577	DENMARK	trunk@10577	AROME	3DVAR	Canari_OI-main	no	edmfm	20091220	20100131	24compared to 36h1.4, 37h1.beta1, 37h1 with lsmixbc
~snh/hm_home/arome_DENMARK_r10577_lsmixbc	DENMARK	trunk@10577	AROME	3DVAR	Canari_OI-main	yes	edmfm	20091220	20100131	24compared to 36h1.4, 37h1.beta1, 37h1 w/o lsmixbc]
~nhx/hm_home/arome_DENMARK_r10577	DENMARK	trunk@10577	AROME	3DVAR	Canari_OI-main	no	edmfm	20100720	20100831	24compared to 36h1.4, 37h1.beta1, 37h1 with lsmixbc
~nhx/hm_home/arome_DENMARK_r10577_lsmixbc	DENMARK	trunk@10577	AROME	3DVAR	Canari_OI-main	yes	edmfm	20100720	20100831	24compared to 36h1.4, 37h1.beta1, 37h1 w/o lsmixbc]
~nhx/hm_home/37h1beta_arome_DENMARK	DENMARK	37h1.beta1	AROME	3DVAR	Canari_OI-main	no	edkf	20100720	20100831	27compared to 36h1.4
~nhx/hm_home/37h1beta_arome_DENMARK_LSMIXBC	DENMARK	37h1.beta1	AROME	3DVAR	Canari_OI-main	yes	edkf	20100720	20100831	27compared to 36h1.4, 37h1.4
~nh/hm_home/37h1beta_DENMARK_edmfm_summer	DENMARK	37h1.beta1	AROME	3DVAR	Canari_OI-main	no	edmfm	20100720	20100831	24compared to 37h1beta1 with edkf_and edkf_STAT
~nh/hm_home/nh/nh/hm_home/37h1beta_edkf_summer_STAT	DENMARK	37h1.beta1	AROME	3DVAR	Canari_OI-main	no	edmfm	20100720	20100831	24compared to 37h1beta1 with edkf default, and edmfm
~nhx/hm_home/37h1beta_arome_DENMARK	DENMARK	37h1.beta1	AROME	3DVAR	Canari_OI-main	no	edkf	20091220	20100131	24compared to 36h1.4, 37h1.4 with lsmixbc
~nhx/hm_home/37h1beta_arome_DENMARK_lmbc	DENMARK	37h1.beta1	AROME	3DVAR	Canari_OI-main	yes	edkf	20091220	20100131	24compared to 36h1.4, 37h1.4
~nh/hm_home/37h1beta_DENMARK_edmfm_winter	DENMARK	37h1.beta1	AROME	3DVAR	Canari_OI-main	no	edmfm	20091220	20100131	24compared to 37h1beta1 with edkf_and edkf_STAT
~nh/hm_home/nh/nh/hm_home/37h1beta_edkf_winter_STAT	DENMARK	37h1.beta1	AROME	3DVAR	Canari_OI-main	no	edmfm	20091220	20100131	24compared to 37h1beta1 with edkf default, and edmfm
~fm/hm_home/37h1b_arome3dvar_fin_w	FINLAND	37h1.beta1	AROME	3DVAR	Canari_OI-main	no	edkf	20091220	20100131	24compared to 36h1.4 , 29 compared to 36h1.4 (FMI)
~fm/hm_home/37h1b_arome3dvar_fin_w_swi	FINLAND	37h1.beta1	AROME	3DVAR	Canari_OI-main	no	edkf	20091220	20100131	24modified swi conversion, compared to 37h1beta1 & without warm up
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~fm/hm_home/37h1b_arome3dvar_fin_s	FINLAND	37h1.beta1	AROME	3DVAR	Canari_OI-main	no	edkf	20100720	20100831	29compared to FMI 36h1.4
~ic/hm_home/arome37h1b	ICELAND	37h1.beta1	AROME	blending	Canari_OI-main	no	edkf	20100520	20100531	21compared to ECMWF,HIRLAM-K05
~nhe/hm_home/37h1beta_arome_ICELAND	ICELAND	37h1.beta1	AROME	blending	Canari_OI-main	no	edmfm	20111120	20111231	24compared to ECMWF,HIRLAM-K05
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~snh/hm_home/ir25ir25L60gy37trunk	IRELAND	37h1 r10386	AROME	3DVAR	Canari_OI-main	no	edmfm	20111120	20111231	24compared to 37h1.beta1
~du/hm_home/ir25stg36h1p4bf1_no3DVARL65	IRELAND	36h1.4.bf1	AROME	blending	Canari_OI-main	no	edmfm	20111120	20111231	24Les no 3DVAR, compared to 37h1.beta1, 36h1.4.bf1 3dvar-L60
~du/hm_home/ir25tg37h1b1B01_no3DVARL65	IRELAND	37h1.beta1	AROME	blending	Canari_OI-main	no	edkf	20111120	20111231	24h ECBD, no 3DVAR, L65, compared to 36h14.bf1 and 37h1.4beta1 with 3h ECBD, 1h ECBD+3dvar+l60
~du/hm_home/ir25tg37h1b1B03_no3DVARL65	IRELAND	37h1.beta1	AROME	blending	Canari_OI-main	no	edkf	20111120	20111231	24h ECBD, no 3DVAR, L65, compared to 36h14.bf1 and 37h1.4beta1 with 3h ECBD, 1h ECBD+3dvar+l60
~lm/hm_home/36h14bf1_lt	LITHUANIA	36h14.bf1	AROME	blending	Canari_OI-main	no	edkf	20091220	20100131	24compared to ECMWF,HIRLAM-HL8, 37h1
~lm/hm_home/37h1b1_lt	LITHUANIA	37h1.beta1	AROME	blending	Canari_OI-main	no	edkf	20091220	20100131	24compared to ECMWF,HIRLAM-HL8, 36h1.4bf1
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~nhe/hm_home/37h1beta_arome_nuuk	NUUK	37h1.beta1	AROME	blending	Canari_OI-main	no	edkf	20111120	20111231	24compared to ECMWF,HIRLAM-K05, DMI-361.5
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~sbl/hm_home/sla_37h1b1_1_lmbc_NEW	SCANDINAVIA_5.5	37h1.beta1	ALARO	3DVAR	Canari_OI-main	yes	-	20091220	20100131	24compared to alaro 36h1.4, 37h1beta1
~nkd/hm_home/BCSW	SCANDINAVIA_5.5	37h1.beta1	ALARO	3DVAR	Canari_OI-main	yes	-	20091220	20100131	24test of modified swi conversion, compared to alaro 36h1.4, 37h1beta1
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~bg/hm_home/sla_37h1bl_l_lmbc_NEW	SCANDINAVIA_5.5	37h1.beta1	ALARO	3DVAR	Canari_OI-main	yes	-	20100720	20100831	24compared to alaro 36h1.4, 37h1beta1

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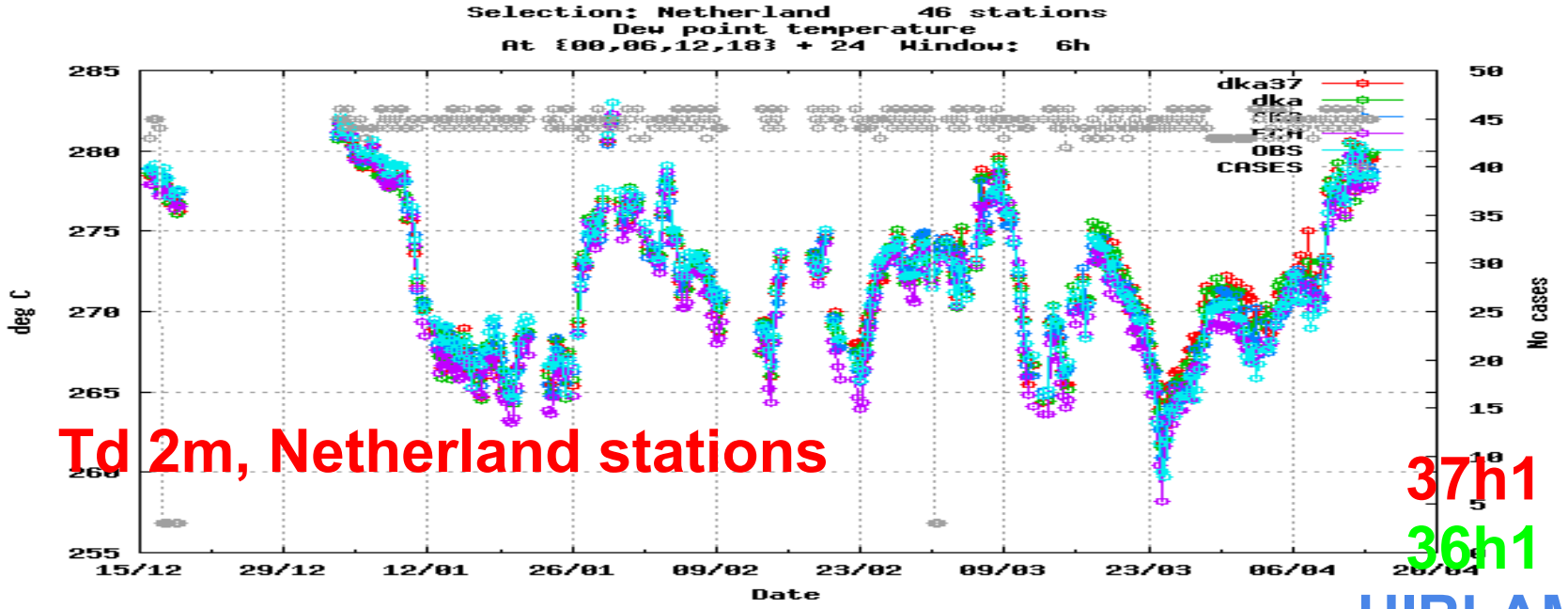
It is necessary to involve many teams...

Example from monitoring of DMI-DKA37h1.2



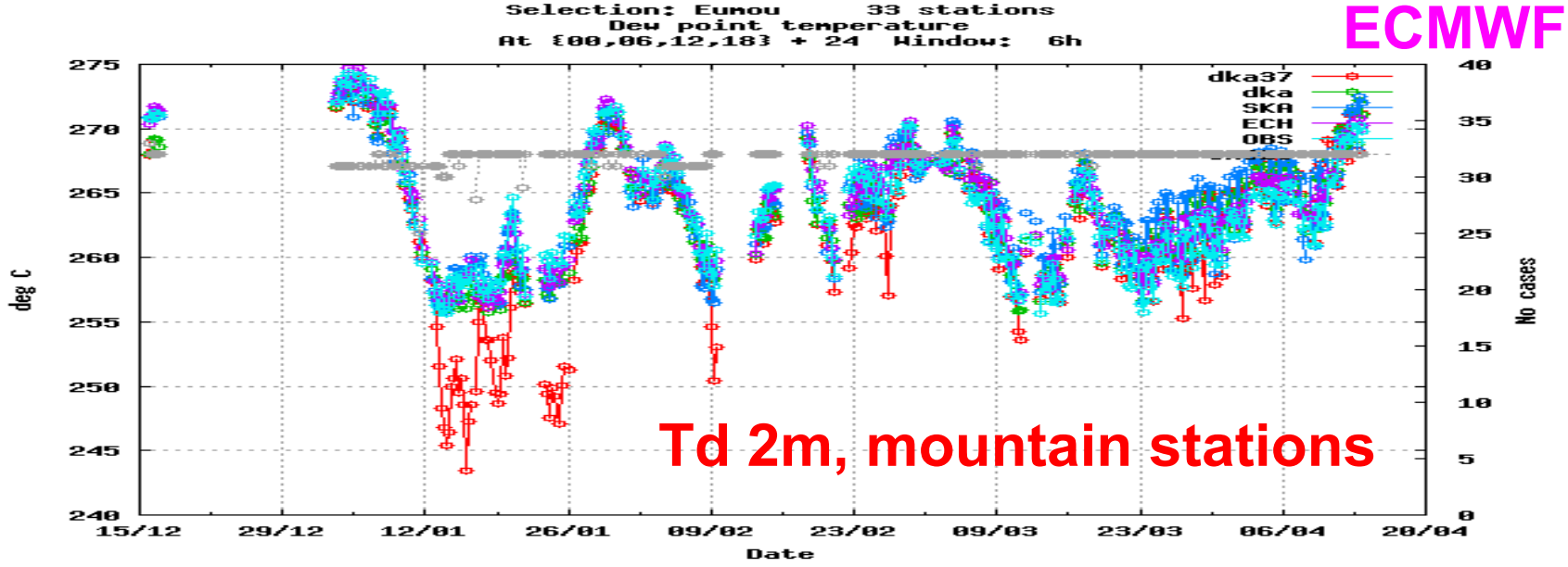
Td 2m, Netherland stations

37h1

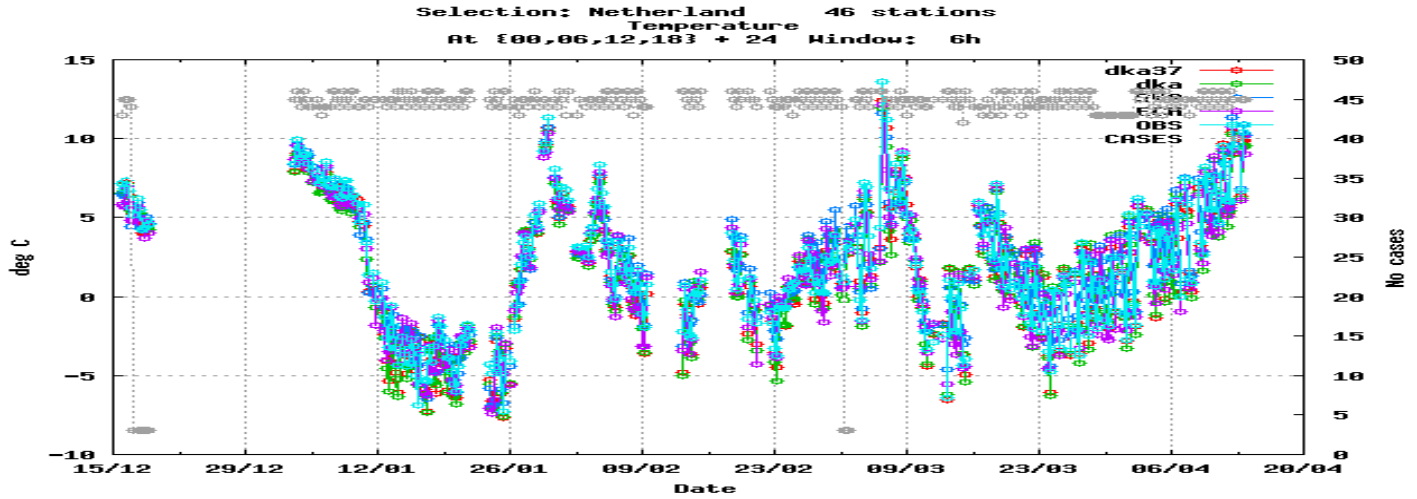
36h1

HIRLAM

ECMWF



Td 2m, mountain stations



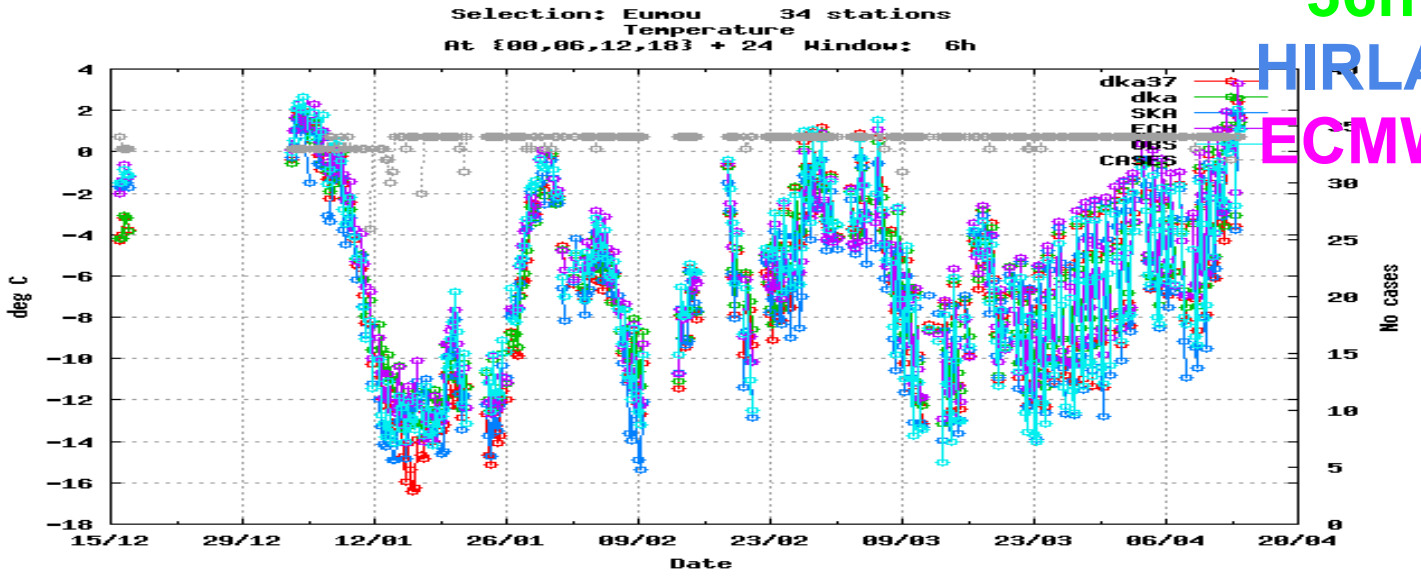
T2m, Netherlands stations

37h1

36h1

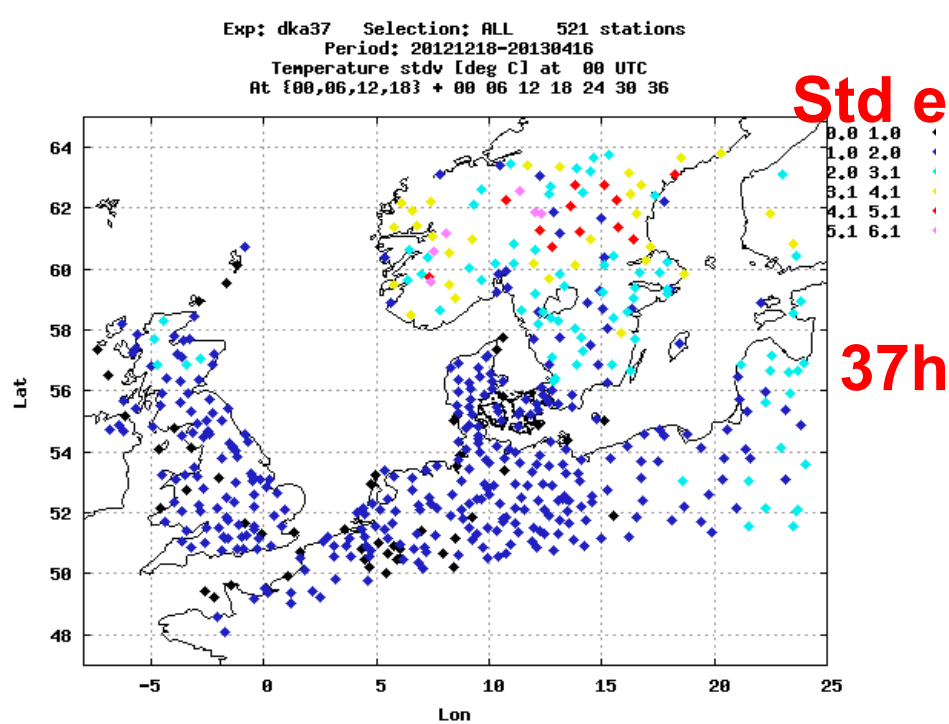
HIRLAM

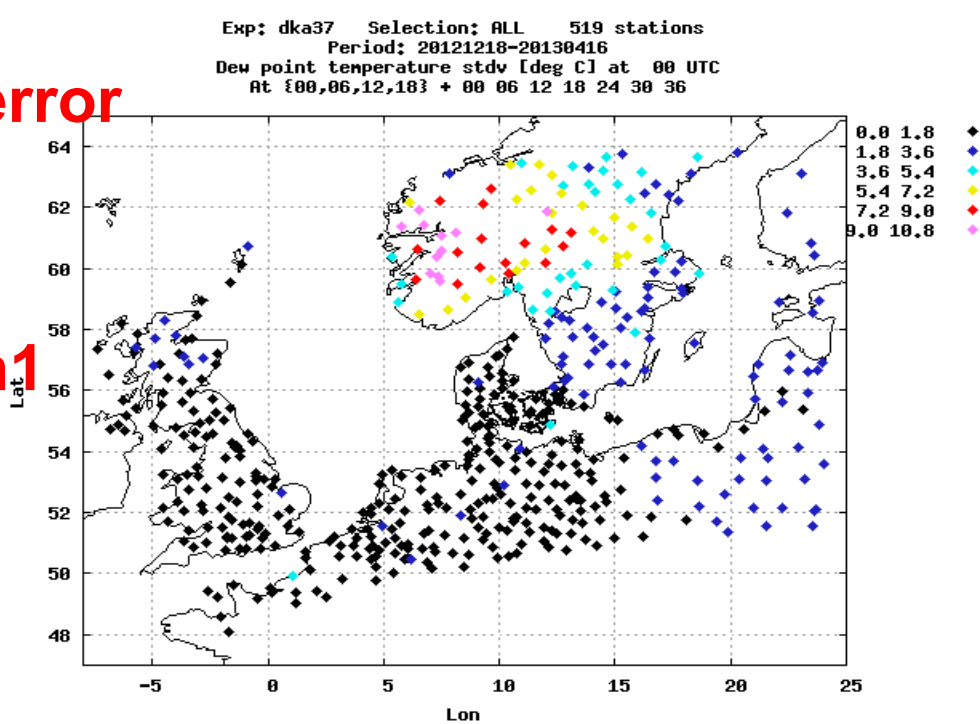
ECMWF



T2m, mountain stations

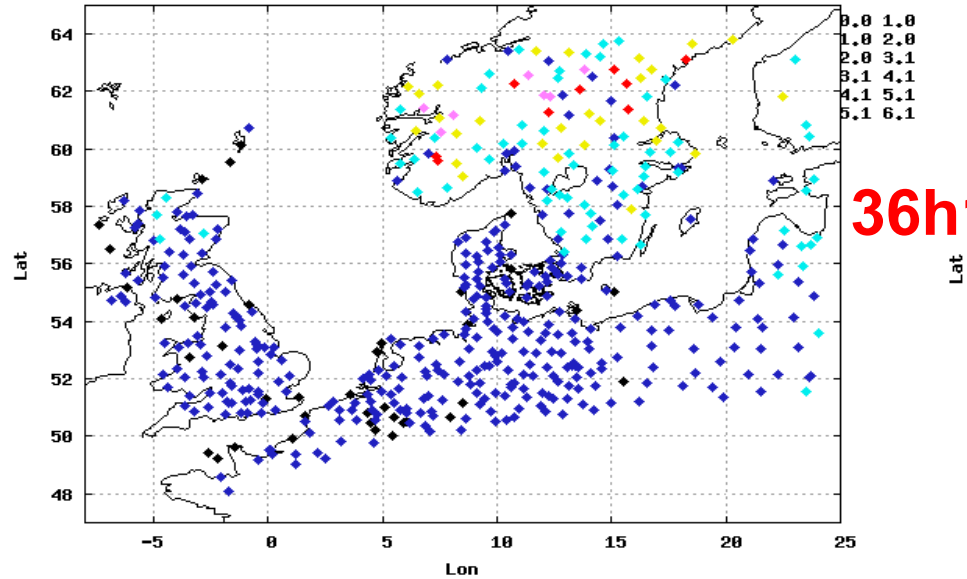
Std error



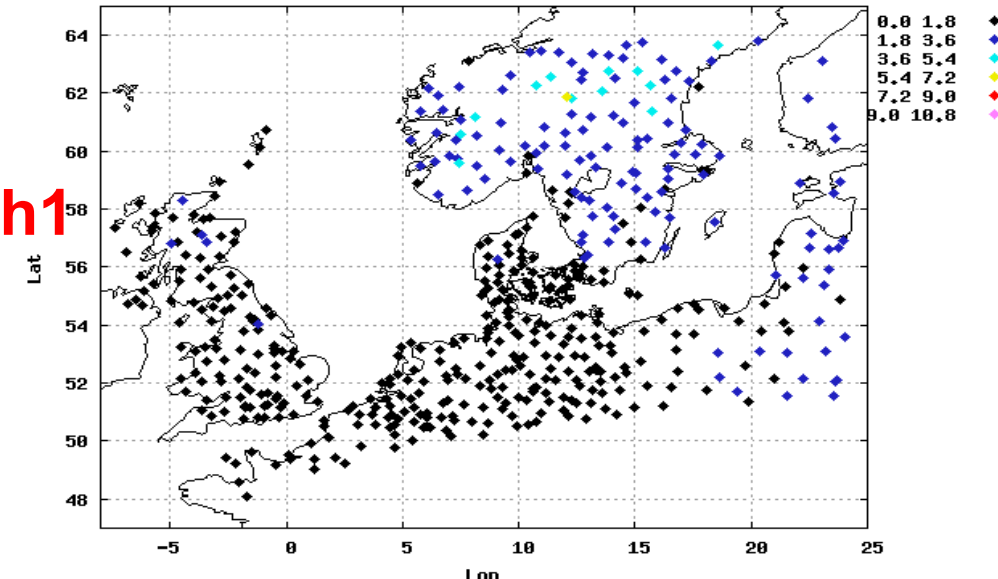


37h1

T2m



Td 2m



36h1

Harmonie monitoring and evaluation tools

gl/monitor/xtool/fldextr/obsver/webgraph…

HARMONIE cycling generates automatically tons of monitoring and diagnostic information. --- One does not have to be technical guru in order to make use of these

- model data for observation and field verifications
- verification and monitoring of cycle diagnosis
  - field and observation verification
  - assimilation aspects: upper air and surface analysis diagnosis per cycle, use of obs, cost function
  - forecast: norms, cpu usage
- all these are conveniently exchangeable and displayable information for model intercomparison of different kinds

... HARP is coming soon!

Summaries

- **Validation of 38h1 has just started and we target for a release within half year**
  - still a number of issues to be addressed
  - some iterations to come via beta-releases and rc.
  - wider participation during the pre-release evaluation & validation & tuning stages helpful
- **Reference HARMONIE is not a Plug-n-Play**
  - technically, this might be a future target
  - QA/performance tuning is not a SEP --- impossible to rely on central quality assurance
  - Active participation in pre-release porting, evaluation, validation & tuning maybe a shortcut for member services
  - Running HARMONIE-RCR benefit all

Perspectives

Validation/verification of new cycles is not merely an acceptance test

- diagnose, identify deficiencies, and eventually, tune
- operational adaptation, pre-operational test/tuning and monitoring can not be isolated from research
  - meteorological part of the work rely on research team
  - there could never be a large enough QA team
- particularly important for KM scale NWP with limited domain size and variability in modeled phenomena

Helpful to devote coordinated efforts and exchange

- Regular Cycle of Reference HARMONIE an useful tool
- joint pre-release validation makes good use of diversity in application and the large pool of expertise in science team